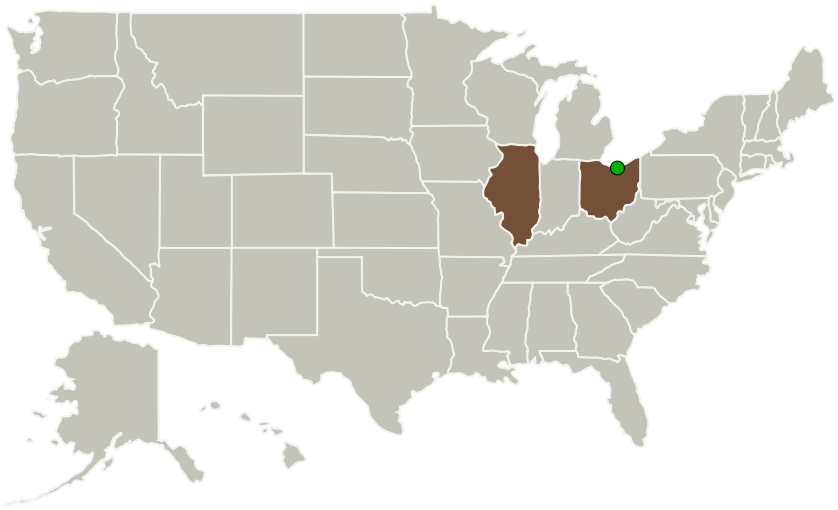
Cost Reduction of IMM Solar Cells by Recycling Substrates Using Wet Chemical Etching, Phase I

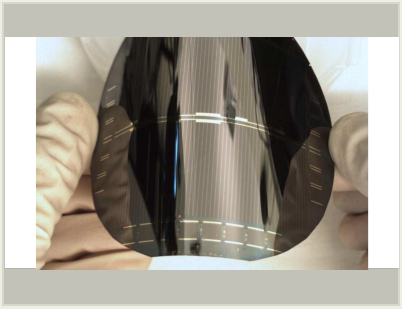
Completed Technology Project (2013 - 2013)

Project Introduction

This program focuses on reducing the cost of substrate reclaim for high-efficiency solar cells fabricated via an epitaxial lift-off (ELO) process, while increasing the number of reuse cycles possible for a given substrate. We will introduce a new multi-layer etch-stop structure into inverted metamorphic (IMM) triple-junction solar cells grown on 100-mm GaAs substrates. The etch-stop structure will be grown between the original GaAs substrate and the ELO release layer, thereby becoming the effective substrate surface after the ELO process. The purpose of the etch-stop structure is to prevent pits and surface damage incurred during ELO from damaging the original GaAs surface. The standard method of reclaiming the GaAs substrate after ELO is to employ chemo-mechanical polishing (CMP) to remove the defect-ridden GaAs surface and chemically polish the underlying GaAs to a yield surface that is suitable for successive epitaxial growth. This process works effectively but reduces resultant substrate thickness and causes some wafer damage itself, which then requires further polishing. These factors accumulate over time, practically limiting the number of reclaim cycles to 5–10 for a given substrate. With the incorporation of the proposed multi-layer etch-stop structure, the defects are isolated in the etch-stop structure, which can be dissolved by successive selective wet chemical etches to produce the original pristine GaAs surface with its original thickness. All mechanical polishing is eliminated in this proposed work, ensuring a constant substrate thickness through repeated substrate reclaim cycles and also drastically reducing the estimated cost of the recycling process to <$1 per substrate.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
MicroLink Devices, Inc.	Lead Organization	Industry Minority-Owned Business	Niles, Illinois
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Illinois	Ohio

Project Transitions

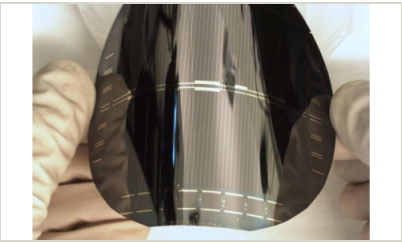
May 2013: Project Start

November 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140421)*

Images



Project Image
Cost Reduction of IMM Solar Cells by Recycling Substrates using Wet Chemical Etching
(https://techport.nasa.gov/image/132163)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
MicroLink Devices, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Christopher Youtsey

Co-Investigator:
Christopher Youtsey

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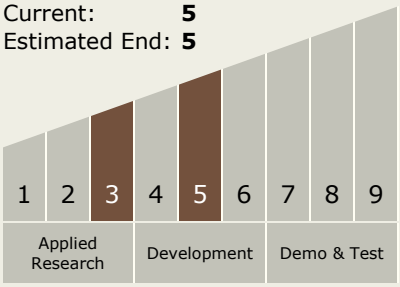
Completed Technology Project (2013 - 2013)

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.1 Power Generation and Energy Conversion
    - TX03.1.1 Photovoltaic

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System